
APPENDIX B

**STRUCTURAL ENGINEERING
DESIGN CRITERIA**

**APPENDIX B STRUCTURAL ENGINEERING DESIGN CRITERIA
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1.0 INTRODUCTION

Control of the design, engineering, procurement, and construction activities on the project will be completed in accordance with various predetermined standard practices and project specific programs/practices. An orderly sequence of events for the implementation of the project is planned consisting of the following major activities:

- Conceptual design
- Licensing and permitting
- Detailed design
- Procurement
- Construction and construction management
- Start-up, testing, and checkout
- Project completion

The purpose of this appendix is to summarize the codes and standards and standard design criteria and practices that will be used during the project engineering, design and construction. These criteria form the basis of the design for the structural components and systems for the project. More specific design information will be developed during detailed design to support equipment procurement and construction specifications. Section 2.0 summarizes the applicable codes and standards and Section 3.0 includes the general criteria for natural phenomena, design loads, architectural features, concrete, steel, and seismic design. Section 4.0 describes the structural design methodology for structures and equipment. Section 5.0 describes the hazard mitigation for the project.

The following Attachments are part of this design criteria:

Attachment	Representative Drawings
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2.0 DESIGN CODES, STANDARDS, LAWS AND ORDINANCES

The design and specification of work shall be in accordance with all applicable laws and regulations of the federal government, the State of California, and with the applicable local codes and ordinances. The following Laws, Ordinances, Codes and Standards have been identified as applying to structural engineering design and construction.

When an edition date is not indicated, the latest edition and addenda at time of plant design and construction shall apply.

2.1 FEDERAL

Title 29, Code of Federal Regulations (CFR), Part 1910, Occupational Safety and Health Standards.

2.2 STATE

- Business and Professions Code Section 6704, et seq.; Section 6730 and 6736. Requires state registration to practice as a Civil Engineer or Structural Engineer in California.
- Labor Code Section 6500, et seq. Requires a permit for construction of trenches or excavations 5 feet or deeper where personnel have to descend. This also applies to construction or demolition of any building, structure, false work or scaffolding which is more than three stories high or equivalent.
- Title 24, California Administration Code (CAC) Section 2-111, et seq.; Sections 3-100, et seq.; Section 4-106 et seq.; Section 5-102, et seq.; Section 6-T8-769, et seq.; Section 6-T8-3233, et seq.; Section ST8-3270, et seq.; Section 6-T8-5138, et seq.; Section 6-T8-5465, et seq.; Section 6-T8-5531, et seq.; and Section 6-T8-5545, et seq. Adopts current edition of UBC as minimum legal building standards.
- State of California Department of Transportation (Caltrans), Standard Specifications, July 1995.
- California Building Code (CBC)

2.3 COUNTY

- Alameda County General Ordinance Code, Title 15, “Buildings and Construction”.

2.4 INDUSTRY CODES AND STANDARDS

The following general design requirements and procedures will be followed in development of project specifications regarding the use of Codes and Industry Standards.

- Specifications for materials will generally follow the standard specifications of the American Society for Testing and Materials (ASTM) and the American National Standards Institute (ANSI).
- Field and laboratory testing procedures for materials will follow standard ASTM specifications.
- Design and placement of structural concrete will follow the recommended practices and the latest version of the American Concrete Institute (ACI), the International Conference of Building Officials, California Building Code (CBC), 1998 Edition and the Concrete Reinforcing Steel Institute (CRSI).
- Design, fabrication, and erection of structural steel will follow the recommended practices and the latest version of the American Institute of Steel Construction Code (AISC) and CBC 1998.
- Steel components for metal wall panels and roof decking will conform to the American Iron and Steel Institute (AISI) Specification for the Design of Light Gage Cold-Formed Structural Members.
- Welding procedures and qualifications for welders will follow the recommended practices and codes of the American Welding Society (AWS).

- Preparation of metal surfaces for coating systems will follow the specifications and standard practices of the Steel Structures Painting Council (SSPC), National Association for Corrosion Engineers (NACE), and the specific instructions of the coatings manufacturer.
- Fabrication and erection of grating will follow applicable standards of the National Association of Architectural Metals Manufacturers (NAAMM).
- Design and erection of masonry materials will follow the recommended practices and codes of the latest revision of the ACI Concrete Masonry Structures Design and Construction Manual and the International Conference of Building Officials, California Building Code, 1998 Edition (CBC).
- Plumbing will conform to the Uniform Plumbing Code (UPC).
- Design will conform to the requirements of the Federal and California Occupational Safety and Health Administration (OSHA and CALOSHA).
- Design of roof coverings will conform to the requirements of the National Fire Protection Association (NFPA) and Factory Mutual (FM).

The following Codes and Industry Standards shall be used:

- California Energy Commission (CEC), "Recommended Seismic Design Criteria for Non-Nuclear Power Generating Facilities in California" - June 1989.
- International Conference of Building Officials, "Uniform Building Code" (UBC), 1997 Edition.
- California Building Code (CBC) 1998 Edition.
- American Society of Civil Engineers (ASCE 7-98), Minimum Design Loads for Buildings and other Structures.
- American Institute of Steel Construction (AISC).
 - S335-89 - "Specification for Structural Steel Buildings-Allowable Stress Design and Plastic Design, and commentary" June 1, 1989.
 - S303-92 - "Code of Standard Practice for Steel Buildings and Bridges"
 - S329-85 - "Allowable Stress Design Specifications for Structural Joints Using ASTM A325 or A490 Bolts."
 - M016-89 - "Manual of Steel Construction Allowable Stress Design, 9th Edition."
- American Iron and Steel Institute (AISI) "Specification for the Design of Cold-Formed Steel Structural Members," August 19, 1986, Edition Cold-Formed Steel Design Manual Parts I-VII."
- AWS D1.1-96 American Welding Society (AWS) "Structural Welding Code-Steel Fifteenth Edition"
- American Concrete Institute (ACI).
 - ACI 318/318R "Building Code Requirements for Structural Concrete (ACI 318-95) and commentary." (ACI 318R-95)

- ACI 318-1/318-1R "Building Code Requirements for Structural Plain Concrete (ACI 318.1-89) (Revised 1992) and Commentary - ACI 318.1R-89 (Revised 1992)"
- ACI 349-85 "Code Requirements for Nuclear Safety Related Structures, Appendix D (Steel Embedments only) (ACI 349-90) and Commentary (ACI 349R-90)", except that anchor bolts will be embedded to develop their yield strength.
- ACI 530-95 "Building Code Requirements for Concrete Masonry Structures and Commentary (ASCE 5-92) (TMS 402-92)"
- ACI 212.3R-91 "Chemical Admixtures for Concrete."
- ACI 302.1R-89 "Guide for Concrete Floor and Slab Construction."
- ACI 350R-89 "Environmental Engineering Concrete Structures."
- Structural and Miscellaneous Steel
 - ASTM A569/A569M-85-Standard Specifications for Steel Carbon (0.15 maximum percent) Hot-Rolled Sheet and Strip, Commercial Quality.
 - ASME STS-1-1992-Steel stacks, except that seismic design shall be in accordance with CBC 1998.
- American Society for Testing and Materials (ASTM). The following codes and standards shall be included as a minimum.
 - ASTM A36/A36M-96 "Standard Specification for Structural Steel"
 - ASTM A53-96 "Standard Specification for Pipe, Steel Black and Hot-Dipped, Zinc Coated, Welded and Seamless"
 - ASTM A276-96 "Standard Specification for Stainless and Heat Resisting Steel Bars and Shapes"
 - ASTM A500-93 "Standard Specification for Cold-formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes"
 - ASTM A695 Rev B-90 "Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel"
 - ASTM A307-94 "Standard Specification for Carbon Steel Bolts and Studs"
 - ASTM A123 Rev A-89 "Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products"
 - ASTM A153/A153-95 "Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware"
 - ASTM A82 Rev A-95 "Standard Specification for Steel Wire, Plain, for Concrete Reinforcement"
 - ASTM A185-94 "Standard Specification for Welded Steel Wire Fabric, Plain, for Concrete Reinforcement"
 - ASTM A615/A615-96 "Standard Specification Deformed and Plain Billet-Steel Bars for Concrete Reinforcement"

- Masonry Institute of America, "Reinforced Masonry Engineering Handbook"
- American Water Works Association (AWWA).
 - AWWA D100 - "Welded Steel Tanks for Water Storage, (AWS D5.2-84) "Addendum D100A - 1989 (AWS D5.2-84A)"
 - AWWA C301-92 "Prestressed Concrete Pressure Pipe, Steel Cylinder Type for Water and Other Liquids"
 - AWWA C302-87 "Standards for Reinforced Concrete Water Pipe Noncylinder Type, Not Prestressed"
- American Association of State Highway and Transportation Officials (AASHTO) (GDHS-2), "A Policy on Geometric Design of Highways and Streets."
- Heating, Ventilating, and Air Conditioning Guide by American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE).
- Uniform Plumbing Code (UPC).
- International Association of Plumbing and Mechanical Officials.
- National Fire Protection Association Standards (NFPA).
- Steel Structures Painting Council Standards (SSPC).
- American Society of Nondestructive Testing (ASNT-TC-1A).

The following general design rules and guidelines will be used in development of project specification regarding Codes and Industry Standards.

- International Standard Organization (ISO) 3945-85 "Mechanical Vibration of Large Rotating Machines with Speed Range from 10 to 200 revs/sec-Measurement and Evaluation of Vibration Severity In Situ."

3.0 STRUCTURAL DESIGN CRITERIA

3.1 NATURAL PHENOMENA

3.1.1 Rainfall

The in-plant surface drainage system will be constructed to accommodate the 10-year storm, as defined by US Bureau Technical Paper No. 40. Temporary facilities will be designed for the 2-year storm.

3.1.2 Wind Speed

Wind loads will be determined from ASCE 7-98, American Society of Civil Engineers, Minimum Design Loads for Buildings and Other Structures. Consideration will be given to along-wind and across-wind responses. This design wind speed will be used to determine wind loads for all structures as discussed in Subsection 3.2.3, Wind Loads.

3.1.3 Temperature

Systems and system component design criteria which require ambient temperature extremes shall use the range from 20°F to 115°F for dry-bulb temperatures.

3.1.4 Seismicity

The plant site is located in seismic Zone 4, as determined from Figure No. 16-2 of CBC 1998.

3.1.5 Snow

The plant site is located in a zero ground snow load area.

3.2 DESIGN LOADS, LOAD COMBINATIONS AND ALLOWABLE STRESSES

Design loads for all structures will be determined according to the criteria described below, unless the applicable building code requires more severe design conditions.

3.2.1 Dead Loads

Dead loads will consist of the weights of the structure and all equipment of a permanent or semipermanent nature including tanks, bins, wall panels, partitions, roofing, piping, drains, electrical trays, bus ducts, and the contents of tanks and bins measured at full operating capacity. The contents of tanks and bins shall not be considered as effective in resisting column uplift due to wind forces, but shall be considered effective for seismic forces.

3.2.2 Live Loads

Live loads will consist of uniform live loads and equipment live loads. Uniform live loads are assumed unit loads which are sufficient to provide for movable and transitory loads, such as the weight of people, portable equipment and tools, planking and small equipment, or parts which may be moved over or placed on floors during maintenance operations. These uniform live loads shall not be applied to floor areas which will be permanently occupied by equipment.

Equipment live loads are calculated loads based upon the actual weight and size of the equipment and parts to be placed on floors during dismantling and maintenance, or to be temporarily placed on or moved over floors during installation.

Consideration will be given to designing appropriate areas of the ground floor for support of heavy equipment such as construction and maintenance cranes. Grating floors will be designed for a minimum live loading of 75 pounds per square foot (psf).

Live loads may be reduced in accordance with the provisions of CBC Section 1606. Live load reduction will not be permitted in areas where equipment laydown loads are considered.

All roof areas will be designed for wind loads as indicated in Subsection 3.2.3, Wind Loads. Pending loading effect due to roof deck and framing deflections will be investigated in

accordance with AISC Specification Article K2. All roof areas will be designed for a minimum of 20 psf live load in addition to calculated dead loads.

Pipe hanger loads for the major piping systems will be specifically determined and located. Piping expansion and dynamic loads will be considered on an individual basis for their effect on the structural systems. Loads imposed on perimeter beams around pipe chase areas will also be considered on an individual basis.

Pipe loads for other areas will be treated as uniform loads per unit floor area, and will be carried to the columns and foundations as dead loads. Pipe loads will not be considered as reliable dead load for uplift.

Equipment loads will be specifically determined and located. For major equipment, structural members and bases will be specifically located and designed to carry the equipment load into the structural system. For equipment weighing less than the uniform live load, the structural system will be designed for the live load.

The combustion turbine support systems will be designed for the following loads:

- Dead loads
- Live loads
- Normal torque loads (turbine)
- Temperature and pressure loads
- Seismic loads
- Emergency loads, such as turbine accident loads, and any temperature and pressure loads present during the emergency

3.2.3 Wind Loads

Wind loads for all structures will be based on ASCE 7-98. A step function of pressure with height under Exposure C conditions will be used (Exposure D if within 1/4 mile of the Pacific Ocean). The Importance Factor shall equal 1.0. Allowance shall not be made for the effect of shielding by other structures.

The overturning moment calculated from wind pressure shall not exceed two-thirds of the dead load resisting moment. The uplift forces calculated from the wind load pressure shall not exceed 2/3 of the resisting dead load. For determining stresses, all vertical design loads, except roof live loads, shall be considered to act simultaneously with the wind pressure.

3.2.4 Steel Stacks

The steel exhaust stacks and supports shall be capable of enduring specified normal and abnormal design operating conditions in combination with wind or seismic loads for the design life of the facility. Effects of wind will include along-wind and across-wind response. The design will address the design considerations, meet the requirements, and utilize the

design methods of Steel Stacks, ASME STS-1-1992. Stack ladders, platforms, and ancillary structures will be designed in accordance with AISC Manual of Steel Construction Allowable Stress Design, Ninth Edition. Design values for yield strength and modules of elasticity of the stack material will depend on the composition of the material and the maximum temperature of the metal at design operating conditions, and will be as prescribed by the ASME Pressure Vessel Code, Section VIII, Division 2, Part AM. Seismic loads shall be in accordance with CBC 1998. The maximum lateral displacement at the top of the stack due to design loads shall be 6 inches/100ft, assuming a rigid base (normal industry accepted deflection).

3.2.5 Seismic Loads

Seismic loads will be determined in accordance with the requirements specified in Section 3.6, Seismic Design Criteria.

3.2.6 Construction Loads

The integrity of the structures will be maintained without use of temporary framing struts or ties and cable bracing insofar as possible. However, construction or crane access considerations may dictate the use of temporary structural systems.

3.2.7 Load Combinations

At a minimum, the following load combinations will be considered. Applicable code prescribed load combinations will also be considered.

- Dead load
- Dead load plus live load plus all loads associated with normal operation of the equipment, e.g., temperature and pressure loads, piping loads, normal torque loads, impact loads, etc.
- Dead load plus live load plus all loads associated with normal operation plus wind load
- Dead load plus live load plus all loads associated with normal operation plus seismic load
- Dead load plus construction loads
- Dead load plus live load plus emergency loads
- Dead load plus wind load
- Dead load plus seismic load

Every building component shall be provided with the strength adequate to resist the most critical effect resulting from the following combination of loads.

- Dead plus floor live plus roof live
- Dead plus floor live plus wind
- Dead plus floor live plus seismic

- Dead plus floor live plus wind plus roof live/2
- Dead plus floor live plus roof live plus wind/2
- Dead plus floor live plus roof live plus seismic

Note: Use live load only where required by CBC 1998 in combination with seismic.

3.2.8 Allowable Stresses

Each load combination shall not exceed the allowable stress permitted by the appropriate code for that combination.

3.2.8.1 Concrete Structures

The required strength (U) shall be at least equal to the following:

- $U = 1.4 \text{ Dead} + 1.7 \text{ Live}$
- $U = 0.75 (1.4 \text{ Dead} + 1.7 \text{ Live} + 1.7 \text{ Wind})$
- $U = 0.9 \text{ Dead} + 1.3 \text{ Wind}$
- $U = 0.75 (1.4 \text{ Dead} + 1.7 \text{ Live} + 1.87 \text{ Seismic})$
- $U = 0.9 \text{ Dead} + 1.43 \text{ Seismic}$
- $U = 1.4 \text{ Dead} + 1.7 \text{ Live} + 1.7 \text{ Earth Pressure}$
- $U = 0.9 \text{ Dead} + 1.7 \text{ Earth Pressure}$

3.2.8.2 Steel Structures

The required strength (S) based on the elastic design methods and the allowable stresses (F_s) defined in Part 1 of the AISC Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings is as follows.

- $S = \text{Dead} = 1.0 F_s$
- $S = \text{Dead} + \text{Wind} = 1.33 F_s$
- $S = \text{Dead} + \text{Seismic} = 1.33 F_s$; frame members and connections will conform to the additional requirements of CBC 1998 Sections 1629 and 2213
- $S = \text{Dead} + \text{Live} = 1.0 F_s$
- $S = \text{Dead} + \text{Live} + \text{Wind} = 1.33 F_s$
- $S = \text{Dead} + \text{Live} + \text{Seismic} = 1.33 F_s$; frame members and connections will conform to the additional requirements of CBC 1998 Sections 1629 and 2213

3.3 BUILDINGS

General design criteria for the architectural systems are discussed in the following subsections.

3.3.1 Architectural System

General design criteria for materials and installation of architectural systems or components will be as follows:

- **Exterior Walls.** These will be metal wall panel systems of the factory assembled or field erected type with exposed fasteners and minimum thickness of exterior sheet of 24 gauge galvanized steel. Installed walls will be watertight and will provide a "U" factor in accordance with the California Administrative Code, Title 24 and the ASHRAE Handbook. Added insulation will be provided for sound absorption on walls enclosing equipment generating excessive noise.
- **Interior Walls.** Where durability is required, interior walls may be constructed of concrete block masonry, structurally designed and reinforced as required. In offices, shops, etc., metal studs with gypsum board will usually be used to form interior partitions. Insulation for sound control will be used where required by design.
- **Fire Exits and Doors.** Fire exits will be provided at outside walls as required by code. Exit signs will be provided. Fire doors will bear an Underwriters Laboratory (UL) certification level for class of opening and rating for door, frame, and hardware. Doors will conform to hollow metal door requirements and have fillers adequate to meet the fire rating.
- **Large Access Exterior Doors.** Large access exterior doors will be rolling steel type with weather seals and windlocks. Components will be formed from galvanized steel, factory assembled, and field painted. Doors will be motor-operated with override manual operation.
- **Metal Roof Deck and Insulation System.** Roof deck and insulation system will be fluted steel decking with minimum depth of 1-1/2 inches. The deck will have interlocking side laps.
 - The completed roof system shall carry an Underwriters Laboratory (UL) Class 90 rating in accordance with Underwriters Laboratory UL 580.
 - The roof system will have a minimum slope of 1/4 inch per foot. Deflection of the roof panels shall not exceed 1/180 of their span.
- **Painting.** Exterior steel material that is not galvanized or factory finished will be painted. Painted color will match or harmonize with the color of the exterior face of the wall panels.
- **Color Schemes.** Color schemes will be selected for overall compatibility.

3.3.2 Prefabricated Metal Buildings

Prefabricated metal buildings (packaged to include exterior doors, wall louvers, windows, skylights, and related enclosure components) will be furnished as follows:

- **Building Enclosure.** Building enclosures will be of manufacturer's standard modular rigid frame construction with tapered or uniform depth rafters rigidly connected at ends to pinned-base tapered or uniform depth columns. Purlins and girts will be cold-formed "C" or "Z" sections conforming to "Specifications for Design of Cold-Formed Steel

Structural Members" of American Iron and Steel Institute. All other members will be hot rolled shapes conforming to "Specification for Design, Fabrication and Erection of Structural Steel for Buildings" of American Institute of Steel Construction. Metal roof coverings will be of pre-finished standing seam panels of 24 gauge minimum.

- Steel. Cold-formed components will conform to ASTM A570, Grade E, 42,000 pounds per square inch (psi) minimum yield for material thickness equal to or less than 0.23 inch, or to ASTM A375, 50,000 psi minimum yield for high tensile strength purlin or girt sections with material thickness equal to or less than 0.23 inch. Roof covering and wall covering will conform to ASTM A446, Grade A, galvanized 33,000 psi minimum yield. All cold-formed components will be manufactured by precision roll or break forming.

3.4 CONCRETE STRUCTURES

Reinforced concrete structures will be designed in accordance with ACI 318-95, Building Code Requirements for Reinforced Concrete.

3.4.1 Materials

The materials described below will be specified and used as a basis for design.

- Reinforcing Steel. Reinforcing steel shall meet the requirements of ASTM A615, Grade 60.
- Cement. Cement used in all concrete mixes will be portland cement meeting the requirements of ASTM C150, Type I or Type II, unless design requires a different type.
- Aggregates. Fine aggregates will be clean natural sand. Coarse aggregates will be crushed gravel or stone. All aggregates shall meet the requirements of ASTM C33.
- Admixtures. Plasticizers and retarders will be used to control setting time and to obtain optimum workability. Air entrainment of 4 to 6 percent by volume will be used in all concrete mixes. Calcium chloride will not be permitted. Interior slabs to be trowel finished may use less air entrainment.
- Water. Clean water of potable quality shall be used in all concrete.

3.4.2 Design

The system of concrete and steel reinforcing strength combinations will be used as follows:

- Concrete strength 4,000 psi minimum (at 28 days)
- Reinforcing strength - 60,000 psi, Grade 60.

3.4.3 Mixes

Concrete strength will be determined by ASTM C39.

3.4.4 Reinforcing Steel Test

Test reports certifying that reinforcing steel is in accordance with ASTM and project specifications will be required.

3.5 STRUCTURAL STEEL

Steel framed structures will be designed in accordance with the CBC 1998 and the AISC Specification for the Structural Steel Building, Allowable Stress Design and Plastic Design, June 1, 1989. In addition, steel framed structures will be designed in accordance with the criteria discussed in the following subsections.

3.5.1 Materials

Structural steel shapes, plates, and appurtenances for general use will conform to ASTM A36. Structural steel required for heavy framing members may consider use of ASTM A572. Structural steel required for tube girts will conform to ASTM A500, Grade B. Connection bolts will conform to ASTM A325. Connections will conform to AISC Specification for Structural Joints, November 13, 1985 edition. Welding electrodes will be as specified by the AWS. All structural steel will be shop primed after fabrication.

3.5.2 Design

All steel framed structures will be designed as "simple" space frames (AISC Specification Type 2), utilizing single span beam systems, vertical diagonal bracing at main column lines, and horizontal bracing at the roof and major floor levels.

Suspended concrete slabs will be considered as horizontal diaphragms after setup and curing. Deflections of the support steel will be controlled to prohibit "ponding" of the fresh concrete as it is placed. Metal roof decks attached with welding washers or fasteners may be considered to provide a structure with lateral force diaphragm action.

Connections will be in accordance with AISC standard connection design for field bolted connections.

3.6 SEISMIC DESIGN CRITERIA

This section provides the general criteria and procedures which will be used for seismic design of building and non-building structures.

The project is located in Seismic Zone 4 according to the California Building Code (CBC), 1998 Edition. The seismic performance objectives for this facility are as follows:

- Resist minor levels of earthquake ground motion without damage
- Resist moderate levels of earthquake ground motion without structural damage, but possibly experience some nonstructural damage
- Resist major levels of earthquake ground motion without collapse, but possibly with some structural as well as nonstructural damage

To achieve these objectives, the facility will be designed in accordance with the 1998 edition of the California Building Code.

It should be noted that structures having one or more of the features listed in Table 16-L and Table 16-M of CBC 1998 shall be designated as having a vertical and a plan irregularity, respectively. All structures, regular or irregular, shall be designed by static or dynamic procedures in accordance with CBC 1998 Section 1629 - Criteria Selection.

It should be also noted that additional provisions for torsional irregularity, overturning, discontinuous lateral load-resisting element, story drift limitation and P-Delta effects, etc. shall be considered in accordance with Section 1630.7 through and including Section 1630.11 of the CBC 1998.

3.6.1 Buildings

The building structural system shall be constructed of steel framing supported on spread footings tied together by perimeter grade beams and floor slab. Lateral forces will be resisted by moment-frames in the short direction, braced-frames in the long direction, and by bracing in the roof steel.

Seismic forces will be computed by the Static Force Procedure given by Chapter 16 of CBC 1998. The seismic dead load, W , will include the total dead load of the structural system, architectural enclosure, and the weight of any attached permanent equipment.

3.6.2 Non-Building Structures

Non-building structures such as tanks and equipment skids will be designed to resist seismic forces in accordance with Section 1634 of CBC 1998.

Nonstructural components and equipment, including piping and cable tray and their supports, will be seismically designed in accordance with Sections 1632 and 1633 of CBC 1998.

4.0 STRUCTURAL DESIGN METHODOLOGY

This section describes the structural aspects of the design of the proposed facility. Each major structural component of the plant is addressed by defining the design criteria and analytical techniques that will be employed.

4.1 STRUCTURES

4.1.1 Turbine Foundation

Turbine foundation will be designed to support the turbine and generator components. The foundation will be designed to resist the loadings furnished by the Supplier and will be constructed of reinforced concrete.

4.1.1.1 Loads

Foundation loads will be furnished by the turbine Supplier and will be superimposed with loads for the foundation itself. Typical loading data will include the following:

- Dead loads
- Live loads
- Wind loads from project specific criteria
- Seismic loads from project specific criteria
- Hydrostatic loads
- Temperature and pressure loads
- Emergency loads such as turbine accident loads

4.1.1.2 Anchor Bolts

The turbines and associated equipment will be securely anchored to the foundation using cast-in-place steel anchor bolts designed to resist the equipment forces.

4.1.1.3 Structural Design

The foundations will be designed and constructed as monolithic reinforced concrete structures using the criteria from Section 3.1, Natural Phenomena and Section 3.4, Concrete Structures. The foundation system will be a rigid mat supported on soils.

The foundation design will address the following considerations:

- Soil bearings and earth pressures
- Allowable settlements
- Equipment, structure, and environmental loads
- Natural frequencies of rotating equipment
- Access and maintenance
- Equipment performance criteria
- Dynamic effects of the rotating machinery

Design loads will be determined in accordance with Section 3.1, Natural Phenomena. Seismic loads on foundation from the turbine will be calculated using equivalent lateral forces applied at the center-of-gravity of the equipment in accordance with the criteria specified in Section 3.6, Seismic Design Criteria.

Load combinations and their respective strength factors for the foundation designs will be as indicated in Subsection 3.2.7, Load Combinations and Subsection 3.2.8, Allowable Stresses.

4.1.1.4 Analysis

The turbine foundations will be designed using static analysis techniques assuming a rigid mat supported directly on soil. The mats will be sized such that the allowable settlement and soil bearing from geotechnical investigation report are not exceeded.

The turbine foundations will be checked for dynamic response of the operating turbine. Manual calculations and simple computer models based on the fundamental principles of dynamic behavior of structures will be used to determine the natural frequencies of the support system. Where soil structure interaction effects are important, low strain soil properties will be used to calculate soil springs using the procedures from Vibrations of Soils and Foundation by Richart, Hall, and Woods or a similar procedure. Each concrete foundation will be analyzed as a rigid body on soil with the equipment modeled as a rigid mass located at its center of gravity and rigidly attached to the foundation. The foundation will be proportioned such that the principal natural frequencies will be at least 25 percent removed from the equipment operating speed. Should the resulting foundation design prove to be uneconomical, the dynamic behavior of the foundation will be evaluated and compared to ISO (3945) Criteria for Vibration Severity. The resultant vibration level will be within the "Good" range of this standard.

A procedure for the dynamic analysis of large fan foundations supported by soil may be used to evaluate the dynamic behavior of the turbine foundations.

4.1.2 HRSG Foundation

The HRSG and its self-supported stacks will be installed on a reinforced concrete mat foundation.

4.1.2.1 Loads

The design of the HRSG and stack foundation will include the following loads.

- Dead loads
- Live loads
- Wind loads
- Seismic loads
- Temperature and pressure loads

4.1.2.2 Anchor Bolts

The HRSG and its stack will be securely anchored to the foundation using cast-in-place steel anchor bolts.

4.1.2.3 Structural System

The HRSG stacks will resist lateral loading as a fixed base cantilevered structure. Lateral stability shall be provided for by integral structural steel columns inherent in the HRSG casing structure.

4.1.2.4 Structural Design

The predominant forces acting on the HRSG and its stack will result from wind or seismic loading.

Wind loads will be determined from ASCE 7-98, American Society of Civil Engineers, Minimum Design Loads for Buildings and Other Structures. Consideration will be given to along-wind and across-wind responses.

Seismic loads will be determined in accordance with CBC 1998 Section 1634, Nonbuilding Structures. The fundamental period will be determined using CBC 1998 Equation 30-10, and will be calculated by both considering and ignoring the structural contribution of lining material. The lower period will be used in the development of the seismic forces. A simultaneous vertical seismic force equal to two thirds of the horizontal seismic force will be considered.

The shell thickness of the stack will account for corrosion allowance. The corrosion allowance will be considered in the generation of seismic loads, but not in the resistance to seismic or wind loads.

Allowable stresses for stiffeners, platform members, and other details will be in accordance with the American Institute of Steel Construction, Allowable Stress Design, Ninth Edition. Allowable stresses for the shell will not be increased for wind or seismic loadings.

The stack will be supported using an octagonal shaped pier on a combined reinforced concrete mat. The foundation will be designed and constructed as a monolithic reinforced concrete structure using the criteria from Section 3.1, Natural Phenomena and Section 3.4, Concrete. The foundation system will likely be a soil supported rigid mat.

The foundation design will address the following considerations.

- Soil bearings and earth pressures
- Allowable settlements
- Structure and environmental loads
- Access and Maintenance

Load combinations and allowable strengths will be as indicated in Subsection 3.2.7, Load Combinations and Subsection 3.2.8, Allowable Stresses.

4.1.2.5 Analysis

Moments, shears, and axial forces for the stack will be calculated using static analysis procedures on a cantilevered member. Longitudinal stresses resulting from axial loads and flexure will be combined and compared to a single allowable stress.

The HRSG and stack foundation will be designed using static analysis techniques assuming a combined rigid mat. The mat will be sized such that the allowable settlement in the geotechnical investigation report is not exceeded. The mat will be proportioned to resist the vertical gravity loads concurrent with the controlling lateral loads.

4.1.3 Buildings and Non-Building Structures

4.1.3.1 Loads

Foundation loads will be determined from the analysis and design of the superstructure and from the support of the equipment contained within the structure. The following loads will be considered:

- Dead loads
- Live loads
- Equipment and piping loads
- Wind loads
- Seismic loads

4.1.3.2 Anchor Bolts

The buildings and non-building structures will be securely anchored to the foundations using cast-in-place steel anchor bolts designed to resist any induced forces.

4.1.3.3 Structural System

The buildings will be designed as an AISC Type 2 simple braced frame and AISC Type 1 moment frames. For the purpose of resisting seismic lateral loads, structures will be classified as regular structures with concentric braced frames in accordance with the definitions of Chapters 16 and 22 of the 1998 California Building Code.

4.1.3.4 Structural Design

The steel frames of the buildings will be designed and constructed using the materials and criteria set forth in Section 3.5, Structural Steel.

Design loads will be determined in accordance with Section 3.1 Natural Phenomena.

Seismic loading for the buildings will be calculated using equivalent lateral forces applied to the structure in accordance with the procedures of CBC 1998, Chapter 16.

The foundations will be designed and constructed using reinforced concrete according to the criteria set forth in Section 3.1 Foundations, and Section 3.4 Concrete. The foundation systems will likely be comprised of shallow soil supported spread footings to resist the column loads and an isolated slab on grade floor system.

The foundation design will consider the following:

- Soil bearing and earth pressures
- Allowable settlements
- Equipment, structure, and environmental loads
- Access and maintenance
- Equipment performance criteria

Load combinations and their respective allowable stresses will be as indicated in Subsection 3.2.7, Load Combinations and Subsection 3.2.8, Allowable Stresses.

4.1.3.5 Analysis

The steel frames will be analyzed using stiffness matrix-analysis techniques on a two-dimensional plane frame or a three-dimensional space frame model. All loads will be applied as static forces. The foundations will be designed using static analysis techniques assuming rigid spread footings. Spread footings will be sized such that the allowable settlement in the geotechnical investigation report is not exceeded.

4.1.4 **Cooling Tower Foundation**

The cooling tower will be designed and supplied by the cooling tower Subcontractor. The cooling tower concrete basin will be divided into cells by partition walls. The basin and the foundation will be on a soil supported rigid mat. The concrete pits for the vertical circulating water pumps will be integral with the tower basin, and also on a rigid mat.

4.1.4.1 Loads

The design of the cooling tower basin and foundation will include the following loads:

- Dead loads
- Live loads (including water)
- Equipment weight and piping loads
- Wind loads
- Seismic loads

4.1.4.2 Anchor Bolts

The cooling tower will be supported by timber columns which will be securely anchored to the basin slab using cast-in-place stainless steel anchor bolts.

4.1.4.3 Structural System

The structural system will be determined by the cooling tower Subcontractor, and designed in accordance with CBC provisions.

4.1.4.4 Structural Design

The predominant forces acting on the cooling tower will result from wind or seismic loading. Wind loads will be determined from ASCE 7-98, American Society of Civil Engineers, Minimum Design Loads for Buildings and Other Structures. Consideration will be given to along wind and across-wind responses.

Seismic loads will be determined in accordance with CBC 1998 Section 1634 - Non-building Structures.

The foundation design will address the following consideration:

- Soil bearing and earth pressures.
- Allowable settlements
- Structure and environment loads

Load combinations and their respective strengths will be as indicated in Subsection 3.2.8.1 Concrete Structures

4.1.4.5 Analysis

The cooling tower foundation will be analyzed using static analysis techniques assuming rigid mat. The mat will be sized in accordance with the requirements of the geotechnical report. The mat will be proportioned to resist the vertical gravity loads concurrent with the controlling lateral loads.

4.2 TANKS

4.2.1 Vertical, Cylindrical Field Erected Storage Tanks

The tank roof will be either the self-supported dome or cone type. The tank bottom will be ground supported, flat bottomed, with a slope of 1 percent. The tanks will be provided with ladders, landing platforms, and handrails as required for access to all working areas. Vents, manholes, overflow piping, and grounding lugs will also be provided as necessary.

A typical tank foundation will be circular ringwall. The interior of the ring will be compacted backfill with a layer of compacted sand or asphalt providing a bearing surface for the tank bottom.

4.2.1.1 Loads

The design of tanks and foundations will include the following loads.

- Dead loads
- Live loads
- Wind loads
- Seismic loads
- Hydrodynamic loads

Allowable soil bearing and settlements values will not be exceeded.

4.2.1.2 Anchor Bolts

Storage tanks will be securely anchored to the foundation using cast-in-place steel anchor bolts designed to resist all induced forces in accordance with AWWA D100-84.

4.2.1.3 Structural System

Storage tanks will resist lateral loading through shear in the tank walls. Overturning will be resisted by anchor bolts connecting the tank wall to the foundation.

4.2.1.4 Structural Design

The foundation will be designed and constructed as a reinforced concrete ringwall using the criteria from Section 3.1, Natural Phenomena, and Section 3.4, Concrete Structures.

The tank structures will be designed and constructed using the criteria established in AWWA D100-84.

Design loads will be determined in accordance Section 3.1, Natural Phenomena. Wind loads will be determined using the velocity pressures specified in Subsection 3.2.3, Wind Loads, multiplied by the appropriate pressure coefficient from CBC Table No. 16-H.

Seismic loads will be determined in accordance Section 3.6, Seismic Design Criteria and AWWA D100-84, Section 13.

The seismic overturning moment will be determined from AWWA D100-84, Section 13.3.3.1 for $Z = 0.4$. The structure coefficient will be determined from AWWA Table 16.

The value of C_1 will be determined from Section 13.3.3.1. The site amplification factor, S , will be determined from Table 17.

Load combinations and their respective allowable strengths will be as indicated in Subsection 3.2.7 Load Combinations, Subsection 3.2.8, Allowable Stresses, and Section 3 of AWWA D100-84.

Design loads will be applied at the center of gravity of the tank. The design of the tank foundation will include the moment resulting from lateral displacement (hydrodynamics) of the tank contents in accordance with AWWA D100-84, Section 133.3.2.

Piping connections will be designed with a minimum 2 inches of flexibility in all directions as specified in AWWA D100-84, Section 135.

4.2.1.5 Analysis

The tank foundation will be designed using static analysis techniques of a circular ringwall. The ringwall will be proportioned to resist the dead load of the tank and the overturning moment determined from AWWA D100-84. The ringwall will also be proportioned to resist maximum anchor bolt uplift force. Circumferential reinforcing steel hoops will be provided in the ringwall to develop the hoop stress produced by lateral soil pressure within the ringwall. The ringwall will be proportioned to resist the vertical gravity loads concurrent with the controlling lateral loads. The tank structure will be designed and proportioned such that during the application of any load, or combination of loads, the maximum stresses as stipulated in AWWA D100-84 will not be exceeded.

4.2.2 Horizontal, Cylindrical, Shop Fabricated Storage Tanks

4.2.2.1 Loads

Foundation loads will be furnished by the tank Supplier and will be superimposed with loads for the foundation itself. Typical loads supplied by the Supplier include the following:

- Dead loads
- Live loads
- Wind loads
- Seismic loads
- Temperature loads
- Hydrodynamic loads

4.2.2.2 Anchor Bolts

The tanks will be securely anchored to the foundation using cast-in-place steel anchor bolts designed to resist all induced forces.

4.2.2.3 Structural System

The tanks will be supported by integral legs or saddle supports designed to resist gravity and environmental loadings.

4.2.2.4 Structural Design

The foundation will be designed and constructed as a monolithic reinforced concrete structure using the criteria from Section 3.1 Natural Phenomena and Section 3.4, Concrete Structures. The foundation will likely be a rigid mat supported directly on soil. When required, the foundation will incorporate an integral containment basin capable of holding 130 percent of the tank's contents.

Environmental loading will be determined in accordance Section 3.1, Natural Phenomena. Wind loads will be determined using the velocity pressures specified in Subsection 3.2.3, Wind Loads, multiplied by the appropriate pressure coefficient from Table No. 16-H of CBC.

Seismic loading will be calculated using equivalent lateral forces applied at the center of gravity of the tank or tank component in accordance with the criteria specified Section 3.6 Seismic Design Criteria.

Load combinations and their respective allowable strengths will be as indicated Subsection 3.2.7 Load Combinations and Subsection 3.2.8 Allowable Stresses.

4.2.2.5 Analysis

The tank foundations will be designed using static analysis techniques assuming a rigid mat. The mat will be sized such that the allowable settlement criteria developed from a detailed subsurface investigation will not be exceeded.

The tanks will be designed by a tank manufacturer in accordance with the AWWA code, ANSI code, and the ASTM standards. Gravity and lateral loadings will be transferred to the foundation by integral legs or a saddle support system.

4.3 EQUIPMENT

4.3.1 Turbine Accessories

The foundations for turbine accessories will be designed to resist the loads furnished by the Supplier, and will be constructed of reinforced concrete.

4.3.1.1 Equipment Loads

Equipment loads will be determined by the Supplier based on project design criteria. Typical loads used for design include the following:

- Dead loads
- Live loads
- Operating loads
- Construction loads
- Wind loads
- Seismic loads

- Temperature loads
- Emergency loads such as turbine accident loads

4.3.1.2 Anchorage

The turbine and associated equipment will utilize steel anchor bolts, fasteners, welds, and other equipment anchorage devices to resist equipment induced forces.

4.3.1.3 Structural Design

The turbine, generator and accessories will be designed to resist project specific design loads. Design loads will be determined in accordance Section 3.1, Natural Phenomena.

Wind loads will be determined using the velocity specified in Subsection 3.2.3, Wind Loads, multiplied by the appropriate pressure coefficient from Table No. 16-H of CBC 1998.

The seismic loading and design of the turbine and accessories will be in accordance with project specific criteria and the CBC. Seismic loading will be calculated using equivalent lateral forces applied at the center of gravity of the equipment or component in accordance with the criteria specified in Section 3.6, Seismic Design Criteria.

The turbine inlet air filtration equipment and inlet air duct support structures shall be designed to resist the loading specified in CBC 1998, Chapter 16. For the purpose of resisting seismic lateral loads, the inlet air duct support structure will be classified as regular or irregular in accordance with the criteria established in CBC 1998 Chapter 16. The procedures for the analysis of regular and irregular structures will be as specified in CBC 1998 Chapter 16 and Subsection 3.6.1, Buildings.

The air duct support structure will resist lateral seismic loading as a Concentric Braced Frame or as an Ordinary Moment Resisting Space Frame as defined by CBC 1998. The design and detailing of the members and connections will comply with the provisions of CBC 1998, Chapter 22.

Lateral forces on elements of structural and nonstructural components will be determined in accordance with CBC 1998 Section 1632 with I_p equal to 1.50, and a_p and R_p in accordance with CBC 1998 Table 16-0. These seismic forces will be combined with forces due to normal operating loads.

Lateral forces on equipment will be determined in accordance with CBC 1998 Section 1632 with I_p to 1.50, and a_p and R_p in accordance with CBC Table 16-0. Equipment bases, foundations, support frames, and structural members used to transfer the equipment seismic forces to the main lateral load resisting system will be designed for the same seismic load as the equipment.

Load combinations will be as indicated in Subsection 3.2.7, Load Combinations. These load combinations are in addition to those normally used in design and those specified in

applicable codes and standards. For all load combinations, including seismic, the stresses in the structural supporting members and connections will remain in the elastic range.

4.3.1.4 Analysis

The turbines and auxiliary equipment will be designed and constructed in accordance with applicable requirements of codes and standards. Stamps will be affixed to denote conformance to the appropriate codes.

4.3.2 Main and Auxiliary Transformers

The main and auxiliary power transformers, transformer equipment, material and accessories will conform to the applicable standards of ANSI C57.12, NEMA TR1, ANSI/IEEE C59.94 and 98, and project specific criteria. The power transformer will be designed, fabricated, and tested in accordance with ANSI C57.12 series, NEMA TR 1, and project specific criteria.

The foundations will be designed to resist the loads furnished by the Supplier and will be constructed of reinforced concrete.

4.3.2.1 Loads

Foundations loads will be furnished by the transformer Supplier and will be superimposed with loads for the foundation itself. Typical loads include the following:

- Dead loads
- Live loads
- Wind loads
- Seismic loads

4.3.2.2 Anchorage

The power transformers, transformer equipment, and accessories will utilize steel anchor bolts, fasteners, welds; and other equipment anchorage devices to resist equipment induced forces.

4.3.2.3 Structural System

The transformer will be regarded as a rigid body for foundation design purposes.

4.3.2.4 Structural Design

The foundations will be designed and constructed as a reinforced concrete structure using the criteria from Section 3.1, Natural Phenomena and Section 3.4, Concrete Structure. The foundation will likely be a soil supported rigid mat. The foundation will incorporate an integral containment basin capable of holding 130 percent of the transformer coolant contents prior to passage through an oil water separator. Design loads will be determined in accordance with Section 3.1, Natural Phenomena. Wind loads will be determined using the velocity

pressures specified in Subsection 3.2.3, Wind Loads, multiplied by the appropriate pressure coefficients from CBC 1998 Table No. 16-H.

The seismic loading and design of the power transformers, transformer equipment, accessories, and foundations will be in accordance with project specific criteria and CBC 1998 Chapter 16. Loading will be approximated using equivalent lateral forces applied to the center of gravity of the equipment or component using the criteria specified Section 3.6, Seismic Design Criteria.

Lateral forces on equipment will be determined in accordance with CBC Section 1632 with I_p equal to 1.50, a_p and R_p in accordance with CBC 1998 Table 16-0. Equipment bases, foundations, support frames, and structural members used to transfer the equipment seismic forces to the foundation system will be designed for the same seismic load as the equipment.

Load combinations will be as indicated in Subsection 3.2.7, Load Combinations. These load combinations are in addition to those normally used in design and those specified in applicable codes and standards. For all load combinations, including seismic, the stresses in the structural members and connections will remain in the elastic range. Structural allowable strengths will be as indicated in Subsection 3.2.8, Allowable Stresses.

4.3.2.5 Analysis

The power transformer foundations will be designed using static analysis techniques assuming a rigid mat. The mat will be sized such that the allowable settlements in the geotechnical report are not exceeded.

4.3.3 Miscellaneous Equipment

4.3.3.1 Loads

Foundation loads will be furnished by the equipment Supplier and will be superimposed with loads for the foundation itself. Typical load include the following:

- Dead loads
- Live loads
- Wind loads
- Seismic loads
- Temperature and pressure loads (as applicable)

4.3.3.2 Anchorage

All miscellaneous equipment will utilize steel anchor bolts, fasteners, welds, and other equipment anchorage devices to resist equipment induced forces.

4.3.3.3 Structural System

Each individual piece of equipment will have its own unique structural system, and it is the responsibility of each manufacturer to assure its adequacy.

4.3.3.4 Structural Design

All miscellaneous equipment will be designed to resist project specific and CBC 1998 specified loads where possible and loads from applicable codes and standards.

Seismic loading and design of miscellaneous equipment will be in accordance with project specific criteria and CBC 1998 Chapter 16. The seismic loading will be calculated using equivalent lateral forces applied to the center of gravity of the equipment or component in accordance with the criteria specified Section 3.6, Seismic Design Criteria.

Lateral forces on equipment will be determined in accordance with CBC Section 1632 with I_p equal to 1.50, and a_p and R_p in accordance with UBC 1998 Table 16-0. Equipment bases, foundations, support frames, and structural members used to transfer the equipment seismic forces to the main lateral load resisting system will be designed for the same seismic load as the equipment.

Load combinations will be as indicated in Subsection 3.2.7, Load Combinations. These load combinations are in addition to those normally used in design and those specified in applicable codes and standards. For all load combinations, including seismic, the stresses in the structural supporting members and connections shall remain in the elastic range. Structural allowable strengths will be as indicated in Subsection 3.2.8, Allowable Stresses.

4.3.3.5 Analysis

All miscellaneous equipment and accessories will be designed and constructed in accordance with applicable requirements of codes and standards.

All structural supports required for the miscellaneous equipment will be designed using static analysis techniques.

4.4 PIPING

The project will include all piping systems necessary for a complete installation. Piping will include all high point vents, low point drains, instrument piping, lube oil piping, steam piping and other piping as required for the complete system. Insulation, hangers, valves, and other piping accessories will also be provided. Piping, pipe supports, and pipe accessories will be constructed of carbon, alloy, and stainless steel.

The foundations and support superstructures will be designed to resist the loads generated by the piping system.

4.4.1 Loads

All piping loads will be determined using project specified loading and CBC specified loads. Typical loadings for a piping system include the following:

- Dead loads
- Live loads
- Wind loads
- Seismic loads
- Temperature and pressure loads
- Test loads

4.4.2 Anchorage

The design and configuration of all hangers and accessories will utilize steel anchor bolts, fasteners, welds, and other pipe anchorage devices. All pipe anchorages will be designed to resist induced forces.

4.4.3 Structural Design

All piping, pipe supports, and pipe accessories will be designed to resist project specific loads, CBC 1998 specified loads, and loads from applicable codes and standards.

Environmental loading will be determined in accordance with Section 3.1, Natural Phenomena. Wind loads will be determined using the velocity pressures specified Subsection 3.2.3, Wind Loads, multiplied by the appropriate pressure coefficients from Table No. 6.7 of ASCE 7-98.

The seismic loading and design of piping systems and pipe supports will be in accordance with project specific criteria. Seismic analysis of piping and components will be designed in accordance with Sections 1632 and 1633 of CBC 1998.

Load combinations will be as indicated in Subsection 3.2.7, Load Combinations. These load combinations are in addition to those normally used in design and the applicable codes and standards specified in mechanical engineering design criteria. For all load combinations, including seismic, the stresses in the structural supporting members will remain in the elastic range. Structural allowable strengths will be as indicated in Subsection 3.2.8, Allowable Stresses.

4.4.4 Analysis

All piping, piping supports, and pipe accessories will be designed and constructed in accordance with applicable requirements of the codes and standards referenced in Mechanical Engineering Design Criteria.

Structural supports required for piping shall be designed using static analysis techniques using the procedures established in Mechanical Engineering Design Criteria.

5.0 HAZARD MITIGATION

The project will be designed to mitigate natural and environmental hazards caused by seismic and meteorological events. This section addresses the structural design criteria used to mitigate such hazards.

5.1 SEISMIC HAZARD MITIGATION CRITERIA

The seismic design criteria for the project will be based on the following considerations:

- Compliance with applicable laws, ordinances, regulations, and standards
- Life safety
- Structural behavior and performance
- Reliability of the plant
- Financial impacts from seismic induced outages
- Seismic probability and magnitude

The project seismic design criteria will be developed to incorporate these considerations using a systematic approach to correlate performance criteria with assumed risk level. The following procedure will be used to establish the design criteria.

- The seismic hazards will be assessed by studying the geologic features of the surrounding area. Major faults will be identified and information collected regarding each fault's proximity, capability, recurrence, and magnitude.
- The seismic risk associated with each source will be assessed considering historical magnitudes.
- Acceleration levels for various structural frequencies will be based on CBC 1998 Figure No. 16-3, Normalized Response Spectra Shapes.
- Appropriate design criteria and analysis methods will be established for each major plant structure, equipment, and component consistent with the seismic performance criteria.

Specific design features that will be incorporated into the plant to mitigate the identified seismic hazards include the following:

- Appropriate analysis techniques will be employed to calculate structure specific seismic loads.
- Plant structures, equipment, piping, and other components will be designed to resist the project specific seismic loads.
- All equipment will be positively anchored to its supporting structure. Nominal uplift capacity will be provided in the absence of calculated overturning forces.
- Anchorages will be designed to resist the project specific seismic loadings.
- The design of piping connections to structures, tanks, and equipment will consider the differential seismic displacements between components.

- Adjacent structures will be seismically isolated from one another.
- Structural elements will be designed to comply with special detailing requirements intended to provide ductility.
- Connections for steel structures will have a minimum load carrying capability without regard to the calculated load.
- Lateral and vertical displacements of structures and elements of structures will be limited to specified values.

The foregoing design features are intended to provide the following degrees of safety for structures and equipment:

- Resist minor earthquakes without damage. Plant remains operational.
- Resist moderate earthquakes without structural damage but with some nonstructural damage. Plant remains operational or is returned to service following visual inspection and minor repairs.
- Resist major earthquakes without collapse but with some structural and nonstructural damage. Plant is returned to service following visual inspection and minor repairs.

5.2 METEOROLOGICAL AND CLIMATIC HAZARD MITIGATION

Specific design features that will be incorporated into the plant to mitigate meteorological and climatic hazards include the following:

- Structures and cladding will be designed to resist the wind forces.
- Sensitive structures will be designed for wind induced vibrational excitation.
- Roofs will be sloped and equipped with drains to prevent accumulation of rainfall.
- Plant drainage systems will be designed to convey the runoff from a rainfall event in accordance with Civil Engineering Design Criteria.
- Ground floor levels of structures will be placed above probable flood levels.
- The plant site will be graded to convey runoff away from structures and equipment.

The foregoing design features will be incorporated in accordance with applicable codes and standards identified in this Appendix.

ATTACHMENT

Representative Drawings

Representative Drawings

Representative drawings of major equipment, structures and systems are listed in Table B-1 below. These drawings are for illustration purposes only, and are not to be used for design and construction.

TABLE B-1

Item No.	Description	Figure No.
1	Typical GTG Foundation	B-1; B-2; B-3
2	Typical STG Foundation	B-4; B-5; B-6; B-7
3	Typical HRSG Foundation	B-8; B-9
4	Typical Acid/Caustic Storage and Containment Foundation	B-10
5	Typical Cooling Tower Basin and Pump Pit	B-11; B-12; B-13
6	Typical Control Building	B-14
7	Typical Transformer Foundation and Containment	B-15
8	Typical Tank Foundation	B-16
9	Typical Gas Turbine Generator (GTG) and Accessories	B-17; B-18
10	Typical Steam Turbine Generator (STG) and Accessories	B-19; B-20
11	Typical Heat Recovery Steam Generator (HRSG)	B-21; B-22
12	Typical Cooling Tower	B-23
13	Typical Transformer	B-24
14	Typical Field Erected Tank	B-25